② Western
April 15, 1978

Department of Plant Sciences,
The University of Western Ontario,
London N6A 5B7

At the Plant Development Workshop held at McMaster last October 29 we agreed that a spring get-together was desirable and that it would be held at Western.

This note then is to invite you and interested colleagues to Western on Saturday, April 15, 1978 for a day's exchange of ideas and information.

Tentatively the following format is planned:

A. Presentation of Papers

B. Concurrent lunch and discussion around poster displays

C. Discussion session "Teaching Plant Development"
An informal exchange of ideas and experiences relating to what can be included in courses in plant development

Obviously the final schedule awaits your response. Could you therefore submit titles and abstracts (for A. and B.) by March 15 so that we can prepare a more definite schedule?

We look forward to hearing from you.

Yours sincerely,

R. I. Greyson,
Associate Professor,
Department of Plant Sciences.

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Department of Plant Sciences
University of Western Ontario
London, Ontario N6A 5B7

SECOND NOTICE

PLANT DEVELOPMENT WORKSHOP

April 15, 1978

The response to our first notice was encouraging. To date I have received abstracts for 8 papers and 6 poster displays. In addition, I have verbal promises of others.

WORKSHOP SCHEDULE

		Room
9:30 - 10:00	Coffee and preliminaries Set up poster displays	B.G. 217
10:00 - 12:30	Presentation of papers	B.G. 116
12:45 - 2:00	Lunch and Poster Display	B.G. 217

We intend to prepare a simple lunch of cold cuts, salad, etc. and hope that a good discussion will develop. (See Note Below)

2:00 - 3:30 "Teaching Plant Development: An Exchange of Ideas"

To encourage you to plan ahead for your contribution to this open discussion I offer the following sample questions:

What central ideas or themes can or should be developed?
What specific kinds of information should be included in courses in plant development?
How do you teach plant anatomy?
What is the place of comparative morphology? intermediary metabolism? etc.
What laboratory exercises can be included?
What texts are available?
ETC. ETC. ETC. ETC. ETC. ETC.

If you have any materials or outlines which you think would contribute to the discussion, please bring them along.

3:30 - 4:00 Wrap up and refreshment.

I enclose a campus map with the Biology and Geology Building circled. Parking is available (25¢) behind greenhouses.

NOTE: SO WE CAN PLAN FOR THE LUNCH, PLEASE LET US KNOW BY THURSDAY, APRIL 13 HOW MANY WILL BE COMING FROM YOUR LABORATORY.

Phone Numbers

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Dick Greyson

D. Greyson

#2

PLANT DEVELOPMENT WORKSHOP #2

UNIVERSITY OF WESTERN ONTARIO April 15, 1978

9:30 - 10:00 Preliminaries Rm BG ~~137~~ 263

10:00 - 12:30 Presentation of Papers Rm BG ~~135~~ 22

1. Development of transfer cells in leguminous roots
W. Newcomb and R. L. Peterson. University of Guelph

2. Root cap structure of Isoetes
Martha Scott and R. L. Peterson, University of Guelph

3. Induction of megatraps in the predacious fungus DACTYLARIA BROCHOPAGA.
J. R. Turnbull and K. Zachariah. University of Waterloo

4. Elemental composition of globoid crystals from protein bodies in different regions of cucumbit embryos.
J. N. A. Lott and J. S. Greenwod. McMaster University

5. Elemental loss from globoid crystals in seed protein bodies as a result of osmium tetroxide fixation.
J. S. Greenwood and J. N. A. Lott. McMaster University

6. Heavy metal induction of callose in bean (Phaseolus vulgaris)
C. A. Peterson. University of Waterloo

7. Differentiation in a stem-derived callus of Ruta graveolens
R. L. Peterson, M. G. Scott and B. E. Ellies. University of Guelph.

8. Evidence for mitotic asymetry
D. Davidson. McMaster University.

12:45 - 2:00 Lunch and Poster Presentations RH 96 ~~137~~ 263

1. LM and SEM study of normal and male sterile-10 (ms10) anthers of Zea mays.
P. C. Cheng. The University of Western Ontario.

2. Xylem regeneration in isolated stem segments of Phaseolus.
C. Hammill. The University of Western Ontario.

3. Endomycorrhizal association of Glomus Mosseae with roots of Phaseolus vulgaris
J. Holley and R. L. Peterson. University of Guelph.

4. The production of haploid plants from anther cultures of tobacco.
B. Modi. The University of Western Ontario.

5. Glandular trichomes of Chrysanthemum.
Janet Vermeer and K. L. Peterson. University of Guelph.

2:00 - 3:30 Informal Discussion Rm BG ~~116~~ 22

"Teaching Plant Development"

3:30 - 4:00 Refreshments.

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45 - 2:00 Lunch and Poster Presentations RM BG ~~217~~ 263

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3:00 - 3:30 Informal Discussion Rm BG ~~116~~ 22

"Teaching Plant Development"

3:30 - 4:00 Refreshments.

D. Davidson. Biology Department, McMaster University, Hamilton.

Evidence for Mitotic Asymmetry.

Roots of Zea mays show a distinct boundary between root cap and meristem; thus, row I cells of the cap can be readily identified in median longitudinal sections. Divisions in these cells show a strict polarity, with spindles always parallel with the long axis of the root. The behaviour of row I and row II cells is not identical, even though they are sisters: e.g. mean nuclear volume was 232 ± 72μm^3 in row I and 180 ± 63μm^3 in row II. In 57 pairs of sister cells, 6 pairs had nuclei with identical volumes and 51 pairs had nuclei of different volumes. The mean difference in nuclear volume was 68μm^3; the range was 6 to 322μm^3. The larger nucleus of each pair was in row I cell in 46 cases and in the row II cell in 5 cases. This suggests: 1) a gradient in row I cells for some factor that regulates nuclear growth, 2) an asymmetrical division, at telophase, across this gradient. For further studies of this situation, row I cells were induced to become binucleate by caffeine treatment. Differences in volumes of sister nuclei were found again, even though sister nuclei share a common cytoplasm. Only 6% of the binucleate cells had a nucleus in the row II position larger than its sister in the row I position. Thus, the behaviour in binucleate cells is further evidence for polarity and asymmetry of mitosis.

DEVELOPMENT OF TRANSFER CELLS IN LEGUMINOUS ROOTS

William Newcomb and R. L. Peterson, Department of Botany and Genetics, University of Guelph, Guelph, Ontario N1G 2W1.

There have been few reports of the occurrence of transfer cells in the roots of angiosperms despite the important role of roots in solute uptake and transport. As part of an ultrastructural study of pea root nodules, wall ingrowths were observed in the pericycle cells of effective and two kinds of ineffective nodules. In addition, wall ingrowths occur in the xylem parenchyma cells in the lateral root tissue adjacent to both effective and ineffective pea root nodules. The xylem parenchyma transfer cells contain many polyribosomes and mitochondria near the wall ingrowths which are located adjacent to pits in the xylem elements. Wall ingrowths begin to form in the pericycle cells five days after inoculation; at this stage the rhizobia are only present in the root hair although the cortical cells have enlarged and some have undergone mitosis. The wall ingrowths in the xylem parenchyma cells begin to form seven to eight days after inoculation which is about the time rhizobia are beginning to be released from the infection threads. In both instances the wall ingrowths begin to form prior to the onset of dinitrogen reduction although previously it has been suggested that a flux of nitrogenous compounds (containing fixed N) induced the formation of wall ingrowths (Briarty, Gunning and Pate 1969). The development of wall ingrowths in the ineffective pea nodules also occurs independently of nitrogen fixation. Similar xylem parenchyma transfer cells are found associated with root nodules of mung bean, soybean, Phaseolus vulgaris, and Vicia faba and with emergent lateral roots of pea. The wall ingrowths located near soybean nodules also begin to develop prior to the onset of nitrogen fixation.

HOLLEY, J. and R.L. Peterson - Department of Botany and Genetics, University of Guelph, Guelph, Ontario -
ENDOMYCORRHIZAL ASSOCIATION OF GLOMUS MOSSAE WITH ROOTS OF PHASEOLUS VULGARIS

Although considerable structural work has been published on mycorrhizal associations in orchids and conifers, there are few detailed developmental studies of endomycorrhizal associations with crop plants. For this reason, the association of Glomus with bean roots was studied using various techniques including light microscopy, fluorescence microscopy, histochemistry, scanning electron microscopy and transmission electron microscopy. Included in the study were the infection phase, cortical cell penetration, arbuscule development and arbuscule degeneration. Although the structural basis for the mechanism of nutrient exchange between the fungus and the root is controversial, evidence from transmission electron microscopy suggests some possible methods for exchange.

ELEMENTAL COMPOSITION OF GLOBOID CRYSTALS FROM PROTEIN BODIES IN DIFFERENT REGIONS OF CUCURBIT EMBRYOS

J.N.A. Lott and J.S. Greenwood, Biol. Dept., McMaster Univ., Hamilton, Ontario, Canada. L8S 4K1

All investigated seeds of Cucurbitaceous plants contain protein bodies with electron dense globoid crystals. The dense globoid crystals are ideal material for energy dispersive x-ray (EDX) analysis studies of elemental composition. In our experiments, the P, K, Mg and Ca content of globoid crystals in different tissues of cucurbit embryos were studied using EDX analysis. In Cucurbita maxima (squash) the globoid crystals from all embryo regions contained P, K, and Mg. Of particular interest was the distribution of the generally immobile element calcium. Calcium was found in highest amounts in the globoid crystals of the radicle and stem regions while globoid crystals in the cotyledon contained little, if any, calcium. In squash the calcium storage thus is spatially arranged in a manner that would aid early growth of the root-shoot axis. The element distribution pattern initially discovered in globoid crystals of Cucurbita maxima protein bodies will be used as a model against which the elemental distribution found in several other cucurbit species will be compared.

ELEMENTAL LOSS FROM GLOBOID CRYSTALS IN SEED PROTEIN BODIES AS A RESULT OF OSMIUM TETROXIDE FIXATION

J.S. Greenwood and J.N.A. Lott, Department of Biology, McMaster University, Hamilton, Ontario, Canada. L8S 4K1

A study was undertaken to determine if standard glutaraldehyde-osmium tetroxide fixation had any effect on the elemental composition of globoid crystals in protein bodies of squash seeds and seeds of several other species. Energy dispersive x-ray analyses of globoid crystals in freeze-dried powders of Cucurbita maxima cotyledon and radicle tissue demonstrated that there was major loss of Mg & K from cotyledon globoid crystals and major loss of Mg, K & Ca from radicle globoid crystals as a result of the fixation. There was also a marked decrease in the P levels. Globoid crystals in glutaraldehyde-osmium tetroxide fixed, embedded and sectioned cotyledon tissue of walnut, hazelnut, sunflower, Helichrysum, cashew, pistachio and Eucalyptus and radicle tissue of Brazil nut had much lower levels of K, Mg, Ca and P than those in glutaraldehyde fixed, embedded and sectioned tissue. Globoid crystals with greatly altered elemental composition remained electron dense. Our results prove conclusively that osmium tetroxide fixation causes major extraction of elements from globoid crystals.

HEAVY METAL INDUCTION OF CALLOSE IN BEAN (*Phaseolus vulgaris* L.)

C. A. Peterson, Biol. Dept., Univ. of Waterloo

Root treatments with cobalt, cadmium, nickel and zinc induced the synthesis of large amounts of callose in the sieve tubes of the treated plants. Callosing was evaluated in the leaf mid-ribs, petioles, stems and roots. In general, greater callosing occurred nearer the leaf, perhaps reflecting an accumulation of the heavy metal at that site. In one experiment, $^{14}CO_2$ was fed to primary leaves of plants pretreated with Co, Ni or Zn for 1,2,3 or 4 days (W. Rauser, Univ. of Guelph). The petiole of the treated leaf was excised and examined for callose; the treated leaf and the remainder of the plant were analyzed for radioactivity. All metal treatments resulted in a significant reduction of ^{14}C-assimilate translocation and also in a significant increase in callose deposition in the petioles. However, variations in the per cent inhibition of translocation were not correlated with the per cent heavily callosed sieve tube plates. Therefore it was concluded that the inhibitory effect of heavy metals on translocatbn was not directly due to their induction of callose in the sieve tubes of the petioles.

TURNBULL, J.R.* and K. Zachariah - Department of Biology, University of Waterloo, Waterloo, Ontario, Canada -
THE INDUCTION OF MEGATRAPS IN THE PREDACEOUS FUNGUS DACTYLARIA BROCHOPAGA

*current address. Department of Botany and Genetics, University of Guelph, Guelph, Ontario, Canada.

The nematatophagous fungus Dactylaria brochopaga was grown and supplied with prey, under different conditions of light intensity and degrees of atmospheric stagnation. Poor ventilation induced the formation of functional giant constricting ring traps (megatraps) which have not been reported previously. Darkness inhibited sporulation. The adaptive significance of these changes will be discussed.

VERMEER, Janet and R.L. Peterson - Department of Botany and Genetics, University of Guelph, Guelph, Ontario -
GLANDULAR TRICHOMES OF CHRYSANTHEMUM

Glandular trichomes on the floral apices of Chrysanthemum morifolium var Dramatic were studied using scanning and transmission electron microscopy correlated with fluorescence and light microscopy. Six to eight-celled glandular hairs are present on ray and disc florets throughout later stages of floral development and floral anthesis. Secreted materials, which have not yet been identified, but are thought to be volatile oils, are released through a single large pore in the cuticle. This material shows a bright red autofluorescence in fresh unstained sections. Mature trichomes contain numerous plastids, mitochondria and lipid bodies as well as an extensive network of vesicular endoplasmic reticulum. No dictyosomes have been observed in the secretory cells. During the stage of active secretion, small wall ingrowths are found in the upper secretory cell in the area where the cuticle is separated from the cell wall. The thylakoids of the plastids in mature trichomes become degenerate. Comparative studies on earlier stages of trichome development are in progress.

PETERSON, R.L., SCOTT, M.G., ELLIS, B.E. - Departments of Botany and Genetics and Chemistry, University of Guelph, Guelph, Ontario -
DIFFERENTIATION IN A STEM-DERIVED CALLUS OF RUTA GRAVEOLENS

Differentiation in a stem-derived callus of Ruta was studied by light and electron microscopy. Shoot apical meristems, some of which initiated leaves, differentiated randomly at the surface of the callus. Apical meristem cells had large nuclei with prominent nucleoli, small vacuoles, mitochondria, endoplasmic reticulum cisternae and leucoplasts. The leaves were radial and had well-developed stomata and chloroplasts of two types, one storing large starch grains and the other with well-developed grana but no starch. Lysigenous and schizolysigenous secretory glands were initiated in the leaves and towards the periphery of the callus. Central cells of the lysigenous glands underwent lysis forming a gland lumen into which lipid-like material from the degenerating cells was released. Schizolysigenous glands formed by the separation of gland cells along the middle lamella and the subsequent development of an epithelial layer surrounding a lumen. The cytology of the epithelial cells was characterized by numerous ribosomes, and the presence of plastids with lipid-like deposits, rough endoplasmic reticulum which occurred either as sheets of cisternae or tubular profiles, and osmiophilic deposits in the cytoplasm. Changes in the epithelial cell walls bordering on the gland lumen indicated that these cells were probably undergoing lysis in older stages of gland development. Both types of glands are probably involved in the secretion of essential oils known to be produced in cultures of Ruta.

SCOTT, Martha G. and R.L. Peterson - Department of Botany and Genetics, University of Guelph, Guelph, Ontario -
ROOT CAP STRUCTURE OF ISOETES

A combined light and electron microscopical study of the root cap of Isoetes was conducted in order to provide a basis of comparison with the root caps of other lower vascular plants. The starch and protein content of root cap cells appeared to differ depending on growth and environmental conditions. In the root caps of roots growing immersed in water, elongated plastids which partially encircled the nucleus of the cell, were present. These plastids, which were oriented parallel to the longitudinal axis of the cell, contained numerous electron-dense deposits and almost no reserves of stored starch. These cells also contained large crystalline protein deposits. However, above the root apical meristem of water-grown plants, the plastids were found to contain large simple or compound starch grains and no protein bodies.

In plants of Isoetes grown with their roots embedded in the soil, root cap cells were found to possess plastids containing either no starch or collections of small starch grains. In some transverse and longitudinal sections, protein crystalloids were completely absent from the cells while in other sections, small protein bodies could be recognized. The protein bodies in rooted plants of Isoetes were smaller and less numerous than those in floating plants.

The root cap of Isoetes was also found to produce copious amounts of mucopolysaccharides. Extremely thick-walled cells at the periphery of the cap were periodically sloughed off. An experimental system for determining the effect of soil and light on starch and protein bodies in root cap cells will be discussed.